TABLE 2.—*Free-air resultant winds, m. p. s., during March, 1923.*

Altitude. m. s. l. (m.)	Broken Arrow, Okla. (233m.)				Drexel, Nebr. (396m.)				Due West, S. C. (217m.)				Ellendale, N. Dak. (444m.)				Groesbeck, Tex. (141m.)				Royal Center, Ind. (225m.)			
	Mean.		5-year mean.		Mean.		8-year mean.		Mean.		3-year mean.		Mean.		6-year mean.		Mean.		5-year mean.		Mean.		5-year mean.	
	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.
Surface	S. 36°W.	2.0	S. 4°W.	2.9	N. 73°W.	0.6	S. 43°W.	0.8	S. 42°W.	1.7	S. 49°W.	2.0	N. 45°W.	4.5	N. 47°W.	2.0	S. 35°E.	1.0	S.	1.5	S. 57°W.	3.2	S. 33°W.	2.1
250	S. 35°W.	2.0	S. 4°W.	3.1					S. 47°W.	2.5	S. 50°W.	2.2					S. 30°E.	1.3	S. 2°E.	2.2	S. 56°W.	3.4	S. 32°W.	2.4
500	S. 28°W.	2.7	S. 8°W.	4.7	N. 82°W.	1.4	S. 46°W.	1.1	S. 55°W.	3.4	S. 53°W.	3.1	N. 49°W.	4.6	N. 55°W.	1.8	S. 3°E.	1.9	S. 9°W.	4.0	S. 56°W.	6.5	S. 42°W.	5.1
750	S. 28°W.	3.2	S. 11°W.	5.9	N. 70°W.	3.7	S. 72°W.	2.3	S. 68°W.	4.3	S. 58°W.	4.2	N. 62°W.	4.9	N. 84°W.	2.4	S. 11°W.	3.2	S. 21°W.	4.9	S. 70°W.	8.9	S. 49°W.	6.5
1,000	S. 35°W.	4.5	S. 23°W.	6.8	N. 63°W.	5.2	S. 83°W.	3.1	S. 71°W.	6.2	S. 60°W.	5.5	N. 70°W.	5.7	S. 89°W.	3.1	S. 31°W.	3.6	S. 33°W.	5.6	S. 75°W.	11.4	S. 59°W.	7.4
1,250	S. 40°W.	5.1	S. 32°W.	7.5	N. 62°W.	6.7	N. 87°W.	4.1	S. 69°W.	7.7	S. 60°W.	7.2	N. 68°W.	6.9	N. 85°W.	4.1	S. 37°W.	3.9	S. 40°W.	5.9	S. 80°W.	12.5	S. 65°W.	8.4
1,500	S. 47°W.	6.0	S. 48°W.	6.9	N. 62°W.	7.1	N. 88°W.	5.2	S. 70°W.	10.4	S. 66°W.	9.1	N. 66°W.	8.3	N. 84°W.	5.5	S. 31°W.	3.4	S. 44°W.	5.8	N. 88°W.	13.5	S. 69°W.	9.1
2,000	S. 63°W.	8.5	S. 62°W.	7.4	N. 67°W.	9.8	N. 83°W.	6.9	S. 76°W.	13.7	S. 71°W.	11.7	N. 64°W.	10.7	N. 82°W.	7.9	S. 47°W.	3.7	S. 58°W.	6.8	N. 81°W.	14.7	S. 75°W.	10.7
2,500	N. 82°W.	7.2	S. 74°W.	7.6	N. 74°W.	12.8	W.	8.8	S. 81°W.	14.5	S. 81°W.	13.2	N. 67°W.	13.9	N. 78°W.	10.7	S. 68°W.	5.9	S. 64°W.	8.7	S. 87°W.	17.6	S. 79°W.	11.7
3,000	S. 86°W.	9.3	S. 81°W.	8.8	N. 77°W.	16.2	W.	11.4	S. 76°W.	15.9	S. 81°W.	13.5	N. 77°W.	16.5	N. 79°W.	11.9	S. 73°W.	7.8	S. 68°W.	9.0	N. 76°W.	21.2	S. 86°W.	14.0
3,500	S. 89°W.	8.6	S. 74°W.	10.3	N. 76°W.	17.8	N. 84°W.	14.8	S. 78°W.	18.6	S. 80°W.	13.3	N. 76°W.	17.3	N. 83°W.	13.7	S. 54°W.	14.5	S. 72°W.	12.0	N. 79°W.	28.6	S. 82°W.	16.5
4,000	S. 85°W.	8.4	S. 81°W.	10.4	N. 71°W.	21.9	N. 76°W.	17.8	N. 86°W.	17.9	S. 84°W.	14.5	N. 87°W.	14.1	S. 89°W.	15.0	S. 60°W.	14.8	S. 67°W.	13.7				
4,500	N. 68°W.	11.6	S. 83°W.	10.9	N. 77°W.	19.3	N. 81°W.	17.5	N. 68°W.	18.8	N. 89°W.	12.6	S. 85°W.	17.3	S. 89°W.	16.3	S. 68°W.	15.3	S. 83°W.	13.3				
5,000	N. 68°W.	11.0	S. 83°W.	11.3	W.	18.1	N. 80°W.	15.7					W.	19.6	N. 88°W.	17.8	S. 68°W.	15.3	S. 81°W.	15.9				

THE WEATHER ELEMENTS.

By P. C. DAY, Meteorologist in Charge of Division.

PRESSURE AND WINDS.

The rapid changes in the atmospheric circulation during the several months of the past winter, referred to previously, which showed some signs of abating in February, were renewed during March, and the month as a whole more than maintained its reputation for unpleasant weather, and, in some portions at least, ran true to tradition concerning lamb-like entrance and lion-like exit.

The pressure for the month as compared with the normal was, as during the preceding month, high over nearly all districts of the United States and Canada, the only exceptions being the Great Lakes and St. Lawrence Valley regions, where, unlike February, the averages were slightly less than normal. Pressure was distinctly above normal over the far Northwest, due to the presence of a well-developed anticyclonic condition that persisted during much of the month over that region.

The pressure for March, 1923, as compared with the preceding month, showed diminution in all parts of the country, as might be expected, though the changes were unusually large over all districts and particularly in the central and northwestern districts, due mainly to the abnormally high pressure of February.

Among the more important anticyclones of the month were the following:

On the morning of the 17th high pressure appeared in the far Canadian Northwest, attended by a sharp fall in temperature, which during the following two days overspread the Great Plains, central valleys and West Gulf States, bringing below-zero temperatures into the upper Mississippi Valley and adjacent regions, and freezing weather almost to the lower Rio Grande Valley. During the following 24 hours it moved rapidly to the South Atlantic coast, losing somewhat in severity of the attending cold, but still giving temperatures in numerous instances lower than ever before reported so late in the month. Again, on the morning of the 27th, high pressure moved into the Northwestern States and during the following 48 hours overspread the northern and central districts to the eastward of the Rocky Mountains, with attending low temperatures, again breaking the record for low temperatures so late in the season at a number of points in the central and northern districts. Before this anticyclone had passed off the Atlantic coast another had appeared in the British Northwest, and by the morning of the 30th had entered the United States with great strength between the Rocky Mountains and the Great Lakes, and penetrated into the central valleys during the last day of March and into the more eastern districts by the first of April. This, too, was attended by severe cold for the season, and many points in central and eastern districts again had the lowest temperatures ever observed so late in spring.

Cyclones were numerous, and frequently well-defined during the first half of the month, particularly over the Great Lakes and to the eastward. The outstanding storm of the month, however, moved from its position in central Texas on the morning of the 11th, to the southern end of Lake Michigan by the morning of the 12th, developing great force as it moved over the middle Mississippi Valley and adjacent territory. After leaving the Great Lakes, however, it lost energy rapidly, and was central over northern New England 24 hours later as a storm of only moderate intensity. This storm was attended by high winds, rain and snow over wide areas adjacent to its path, and local storms of great severity occurred, attended by loss of life and large damage to property, the details of which appear in other parts of this Review.

Aside from the storms of the 11th and 12th, other severe windstorms occurred locally during the first week of the month, and again on the 15th and 16th. The latter half of the month was comparatively free from storms of this character.

The usual notes concerning damaging storms appear in a table at the end of this section.

The frequent changes in pressure distribution during the month greatly complicated the wind systems, and the prevailing directions were not from common points over extensive areas, as shown on Chart VI.

TEMPERATURE.

March was a month of frequent and sharp temperature changes, and on many occasions the weather bore the earmarks of winter more prominently than those of spring. This was particularly the case in portions of New England, where, on account of the long, cold winter, and the frequent lack of proper fuel or of even any at times, the hopes undoubtedly nurtured that March would bring relief were cruelly disappointing.

The first two weeks were moderately warm over the districts from the Rocky Mountains eastward, save during the second week when it was distinctly cold over the

Northeastern States, and mainly cool during both weeks from the Rocky Mountains westward.

The first few days of the month were especially warm over the upper Mississippi and lower Missouri Valleys and portions of the Middle Atlantic States, where the day temperatures were, in many cases, as high as or higher than ever before observed so early in the month. After the middle of the month, however, sharp changes to colder weather were frequent, and the week ending March 20th was unusually cold over the great central valleys and less so over nearly all other portions of the country, only small areas along the immediate Atlantic and Pacific coasts having temperatures above normal. Toward the end of the week a cold wave of unusual severity overspread practically all central and eastern districts and temperatures lower than ever before observed so late in March were reported from many sections.

The week following, ending March 27th, continued cold over practically all parts of the country, only small areas in the extreme East and far West having averages for the week above the normal. The week was particularly cold from the Dakotas eastward to the upper Lakes, where the averages were from 6° to 15° below normal. The final days of the month had two short periods of severe cold, confined principally to the central and eastern districts, where on both occasions temperatures lower than any previously recorded so late in spring were observed at numerous points. In the far West, however, there was a rapid warming up during the last few days of the month, and temperatures in portions of California and adjacent States were as high as ever observed in March.

For the month as a whole the average temperature was slightly above normal over the Atlantic coast States from southern Pennsylvania to Florida, over most of California and Oregon, and in portions of Washington, Idaho and Montana. Over all other portions of the United States, and generally over Canada, the monthly temperature averages were less than normal, and in the vicinity of the upper Lakes the month was among the coldest of record for March.

The principal warm periods were the first few days of the month in the Great Plains and Mississippi Valley, and to the eastward; on the 11th to 13th over most of the Gulf and South Atlantic States; on the 23d over the Northeastern States; and from the Rocky Mountains westward during the closing days of the month.

Important cold periods were from the 3d to 5th over the far western States; from the 8th to 9th in the Northeastern States; from the 18th to 20th over most districts from the Rocky Mountains eastward, and over much of the same area during the last few days of the month.

PRECIPITATION.

Over much of the country from the Rocky Mountains eastward the precipitation for March, 1923, was in excess of the normal, and was generally well distributed through the month. However, an extensive area from Ohio and Kentucky northeastward to New England had somewhat less than usual, and in portions of the South Atlantic and Gulf States there were smaller areas with less than the normal amounts, particularly over the Florida Peninsula, and notably in the more southern portions. At Miami drought has continued since the first of the year, the total precipitation for the entire three months amounting to but slightly more than one inch, the least ever recorded at that station for a similar period.

West of the Rocky Mountains and in portions of the upper Missouri Valley and nearby territory, there was practically everywhere less than the normal precipitation, the deficiencies over California and the western districts of Oregon and Washington being particularly large.

In California the month was notably dry, San Francisco reporting the least rainfall in March for 74 years, the entire period of weather observations at that place. Likewise at Fresno, Sacramento and other points the outstanding feature of the weather was the almost entire absence of precipitation, a condition most unusual for that month. As February was also markedly dry it is becoming inevitable that there will be a serious shortage of water for irrigation and hydroelectric purposes during the coming summer. Similar conditions existed over much of Oregon and to a less extent in adjacent States.

The more important periods with extensive precipitation were as follows:

From the 3d to 5th when precipitation occurred very generally from the central Rocky Mountains eastward, the amounts being mostly light, except in portions of the middle and upper Mississippi and lower Missouri Valleys; on the 6th and 7th when general rains or snows prevailed from the Southern Plains northeastward and eastward, the falls being heavy in portions of the middle Mississippi and lower Ohio Valleys and Atlantic coast States; on the 11th to 13th from the eastern portions of the Great Plains to the Atlantic, the falls being heavy in portions of the Mississippi and lower Missouri Valleys, and locally in the Gulf and Atlantic coast States; from the 15th to 17th when precipitation was again general over the same region, the amounts being generous to heavy over much of the territory covered. More or less rain occurred over the Atlantic coast districts on the 19th and 20th, and again on the 22d and 23d. The latter part of the month was without extensive or heavy precipitation, save in Texas where heavy rains occurred at numerous central and eastern points on the 27th and 28th.

SNOWFALL.

The snowfall was generally more than normal over the northern Plains and in northern districts to eastward. There was somewhat more than the average of March in districts to northward of a line joining Boston and Buffalo; and there was much more than normal to northward of a line from Detroit through Chicago to Kansas City. From central Iowa to east-central Michigan there was a notable fall on the 11th and 12th, the snow in much of the area being unusually wet, loading wires and trees till vast damage resulted, also hampering traffic greatly. Two additional heavy falls followed within a week's time, still further delaying traffic. The earlier of these two on the 14th–15th, was light east of Lake Michigan, but was remarkably heavy in eastern Nebraska and western Iowa; the later accompanied the marked fall in temperature on the 18th.

In northern Michigan, especially the eastern part of the upper peninsula, there were numerous snowstorms, but that of the last few days of the month, when high winds drifted the snow greatly, was especially troublesome. At Sault Ste Marie, as at several points in Wisconsin, Iowa and Missouri, the snowfall of the month was greater than that of any preceding month of record.

In northwestern Wisconsin and central Minnesota and thence westward to central Montana, the snowfall of the month was not particularly heavy, and in the southern and central Appalachian districts, also nearly everywhere south of central Ohio and central Illinois there was either no snowfall or comparatively little.

In the far West the snowfall of March was decidedly light in the California and Nevada mountains, and elsewhere was usually less than normal, save in Colorado, the northern Rockies and the Black Hills region. The end of the month found the snow stored for the water flow of spring and summer mainly less favorable than normal in the States that border Mexico and in the Pacific States. From Colorado to Montana the snow depths indicate a good supply, and in the middle and northern Plateau about an average supply.

In the northern portions of New England, New York, and Michigan the snow that still remained at the end of March was very deep, and some stations reported a greater depth of snow on the ground than at any previous time during their periods of record.

RELATIVE HUMIDITY.

For the country as a whole the average relative humidity was less than normal. The dry conditions in the West were clearly indicated by the deficiency in the percentage of relative humidity, amounting in the drier localities to 25 per cent or more.

Over the central and eastern districts where precipitation was more nearly normal, or above, and of frequent occurrence, and where cool weather persisted, which would ordinarily indicate higher humidity conditions, the averages for the month were likewise less than normal in many sections. In the central and southern Rocky Mountain regions, and over the Great Lakes, portions of New England, and locally in the Southeastern States the relative humidity was above normal.

SEVERE LOCAL STORMS, MARCH, 1923.

[The table herewith contains such data as have been received concerning severe local storms that occurred during the month. A more complete statement will appear in the Annual Report of the Chief of Bureau.]

Place.	Date.	Time.	Width of path.	Loss of life.	Value of property destroyed.	Character of storm.	Remarks.	Authority.
			Yards.					
St. Joseph, Mo., and vicinity	3	5.40 p. m.	50		$50,000	Tornado	Many buildings damaged or blown down. Nine persons injured.	Official, U. S. Weather Bureau.
Western Wisconsin	3-4					Rain, sleet, and snow.	Miles of telephone, telegraph, and electric wires blown down. Railroad traffic paralyzed for a day.	Capital Times (Madison, Wis.); Sentinel (Milwaukee, Wis.).
Pittsburgh, Pa., and vicinity	4	P. m.		2		Wind	Many persons injured by flying glass; property damage heavy; barns destroyed; rail traffic delayed.	New York World (N. Y.); Baltimore Sun (Md.).
Palmyra, Mo. (near)	5	9 p. m.	100		3,000	Wind and rain	Houses and other buildings damaged	Official, U. S. Weather Bureau.
Central Alabama and Georgia	6	P. m.				do	Many buildings damaged; power lines, telephone and telegraph service crippled; two persons injured. Montgomery streets flooded.	Advertiser (Montgomery, Ala.).
Calhoun Falls, S. C	6	P. m.				Wind	Several houses unroofed	Official, U. S. Weather Bureau.
New York and adjacent States	6-7			3		Glaze and snow	Street-car service demoralized; trains delayed; wires down; harbor traffic almost tied up. Several persons injured.	Do.
Jackson, Mo	11	7:45 p. m.	225		50,000	Tornado	Track of damage one mile long; two persons injured.	Official, U. S. Weather Bureau.
Deanburg and Pinson, Tenn	11	8 p. m.	300	20	100,000	do	Seventy persons injured; 60 dwellings wrecked; freight train blown from track; wire communication cut off.	Official, U. S. Weather Bureau; News Scimitar (Memphis, Tenn.); Register (Springfield, Ill.).
Gallatin County, Ill	11	9 p. m.	300		10,000	do	Buildings and trees destroyed or damaged	Official, U. S. Weather Bureau.
Illinois (southern)	11-12					Wind	House blown off foundations; wire service crippled.	Do.
Indiana, especially southern	11-12				300,000	do	Heavy property damage; public utilities companies suffer great loss; several persons injured.	Official, U. S. Weather Bureau; Evansville Journal (Ind.).
Kentucky (western and central).	11-12			9	1,500,000	do	Buildings blown down or damaged; much loss of live stock; wire lines crippled.	Official, U. S. Weather Bureau; Lexington Leader (Ky.).
Tennessee	11-12				600,000	do	Buildings demolished or damaged; wire lines put out of business; some stock killed; trees uprooted or broken.	Official, U. S. Weather Bureau; Nashville Banner (Tenn.).
Arkansas, Mississippi, and northern Alabama.	11-12			2		do	Buildings and wire lines blown down or injured; mules and horses killed; windows blown in.	Commercial Appeal (Memphis (Tenn.); Nashville Banner (Tenn.).
Wisconsin, eastern Iowa, and northern Illinois.	11-12			3		Wind and snow	Wires broken down; trees destroyed; windows broken; rail and highway traffic greatly delayed.	Official, U. S. Weather Bureau; Wisconsin News (Milwaukee, Wis.); New York Times (N. Y.).
Western and southern Michigan.	11-12				2,000,000	Wind and snow	*Public utilities suffer heavy losses; other* general damage done; serious delays of traffic.	*Menominee* Herald-Leader (Mich.). Free Press (Detroit, Mich.).
Ohio	12			2		Wind	Six persons hurt; great property loss	Baltimore Sun (Md.). Tribune (New York, N. Y.).
Boydville, Ga	13			2		do	Several buildings blown down	Evansville Journal (Ind.).
Northwestern Mississippi	15	P. m.		16	350,000	Tornado	Town of Savage completely wiped out; many persons injured and several hundred made homeless.	Commercial Appeal (Memphis, Tenn.). Indianapolis Star (Ind.).
Selmer, Tenn. (near)	15					Wind	Much timber blown down	Official, U. S. Weather Bureau.
Indianapolis, Ind	15-16	P. m.			40,000	do	Heavy damage to public utilities and to buildings.	Indianapolis News (Ind.).
Central and western New York.	15-16			1		Wind and rain	Roofs, chimneys, and trees damaged considerably; property loss heavy; wire lines crippled.	Star (Oneonta, N. Y.). Press (Binghamton, N. Y.).
Yakima, Wash	19					Wind	Roofs, windows, and small buildings wrecked; some trees destroyed.	Official, U. S. Weather Bureau.
South Carolina (northwestern).	23				30,000	Thunderstorms	Considerable damage, especially to buildings, by wind squalls.	Do.